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Veröffentlichungsversion / Published Version

Konferenzbeitrag / conference paper

Zur Verfügung gestellt in Kooperation mit / provided in cooperation with:

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Empfohlene Zitierung / Suggested Citation:

Lindström, H. L. (1998). Response distributions when TDE is introduced. In A. Koch, & R. Porst (Eds.), *Nonresponse in survey research : proceedings of the Eighth International Workshop on Household Survey Nonresponse, 24-16 September 1997* (pp. 97-111). Mannheim: Zentrum für Umfragen, Methoden und Analysen -ZUMA-. <https://nbn-resolving.org/urn:nbn:de:0168-ssoar-49716-6>

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Response Distributions when TDE is Introduced¹

HÅKAN L. LINDSTRÖM

Abstract: *Three surveys at Statistics Sweden use Touch-tone Data Entry (TDE) for their data collection: Producers Price Index (PPI), Short-term Turnover Statistics for Domestic Trade and Services (STS), and Statistics on Municipalities' Costs for Social Assistance (MCSA). PPI is a monthly survey, MCSA is a quarterly and STS has both monthly and quarterly parts. MCSA is a census and the two other surveys use the same sample each month during the year. All three are mandatory surveys. The TDE implementation in PPI was preceded by a large experiment. Methodological studies were also made in STS and MCSA. Details are given to show the development of TDE and overall response rates over time and to what extent the surveys have turned into multi-mode surveys. The TDE response rates differ in these surveys. This report presents the differences and offers some explanations to them. It is a condensed version of a report written for Statistics Sweden. The complete report will include the details of MCSA and response distributions for all months of 1997.*

Keywords: *touch-tone data entry; nonresponse; multi-mode survey.*

1 The conclusive TDE experiment in the 1993 PPI

Since we knew that TDE already was in use at other statistical agencies, it was natural to investigate if it could be successfully adapted in some Statistics Sweden's surveys. Research reports by Clayton, R. (1989), Phipps, P.A. and Tupek, A. R. (1990) and Weeks, M. F. (1992) convinced us that the prospect of successful implementation was good.

About half a dozen surveys have the restricted number of numerical variables which is a necessary prerequisite for the use of TDE. PPI was the first choice for test and implementation as its sample size was large enough to make cost reductions possible. We did an experiment in that part of the sample for which TDE responding is most

¹ Acknowledgment: The author would like to thank Siv Grimsvik-Laskaridis, Gunilla Hedengren, Erik Henriksson and Karin Larsson (all at Statistics Sweden), who all have provided information and helpful comments on the report.

complicated, which is for imported goods. There were two complications which were not tested in any other application we knew of. Prices of imported goods might be given in different currencies during the year. For low priced goods it was necessary to register the price with a decimal point. If the respondent could manage these complications it would be sensible to recommend TDE also in less demanding applications.

The functioning of TDE was tested in an embedded experiment. 200 companies were sampled randomly from the "import prizes part" of the regular survey in October 1993. The experiment was extended into November and December to show if there was a persistent effect or a trend. The size of the net sample was 181, 180 and 179 respectively. The standard group was not offered to use TDE and continued to use the standard data collection method (shuttle paper form). It consisted of 474 companies. The standard and experiment groups are compared regarding response rates in Table 1.

Table 1: Response rates of net sample in experiment and standard groups

Sample	October	November	December
Treatment group	0.86	0.94	0.94
of which by TDE	0.70	0.74	0.74
Standard group	0.93	0.93	0.92

The total response rate in the experiment group is seven percentage points lower in October but one respectively two percentage points higher during the last two months. Too detailed information given to the respondents may explain the low response rate of the experiment group in October. It gave the impression of putting a heavier burden on the respondent than before. The increase in both general and TDE response rates of November and December may depend partly on the learning process, partly on more concise and efficient information about TDE in the information letter for these months. It was obviously important that the experiment continued for three months. The seven percentage points decrease of the overall response rate in September might otherwise have been a conclusive argument against implementation of TDE. The final TDE-use in the experiment is shown in Table 2.

Table 2: TDE users in December 1993

Sample group	Number	Per cent of :		
		gross sample	net sample	offered TDE
Gross sample	200	100	--	--
Net sample	179	90	100	--
Offered TDE	155	78	87	100
Used TDE	132	66	74	85

Each TDE respondent has to register the good's identity and price for at most ten types of goods or services together with company identity. When there is no new price he/she can use simple codes to register either if the price is the same as in the previous month or if they did not sell that kind of goods.

Table 3: Response time per item and type of goods - in seconds

Type of price information	October		November		December	
	average	median	average	median	average	median
Same price	35.5	32.0	36.0	31.0	32.1	30.0
Did not sell	35.5	32.5	42.3	35.0	35.2	33.0
New prices	59.1	57.0	58.4	54.0	53.4	55.0

To register "new price" takes almost twice as long as the two other alternatives. The high average value for "did not sell" in November found no explanation. There is some tendency towards faster registration from September to December. The average time per response occasion was reduced from 122 to 102 seconds and the median time from 87 to 82. We guess that respondents eventually learn to spend less time to listen to instructions. Less than ten per cent of the respondents registered more than four prices at one occasion. During the three months only about a dozen contact persons used more than four minutes to register. The maximum time used was eight minutes and ten seconds. The total time to collect the information and prepare it for TDE registration is not known.

107 companies used TDE at all three occasions. 150 (84 %) of 178 companies, initially eligible for TDE, used TDE at least once. Only half a dozen respondents stopped using TDE after having tried it and became nonrespondents. We also made a debriefing

interview about the attitude to TDE after the September survey with one of ten of the experiment group. Few expressed a negative opinion to TDE.

We regarded the final TDE rate of the net sample to be very good. About 90 per cent of all companies had the technical facilities to use TDE at that time. The outcome of the test was judged as successful considering both cost and data quality aspects. Since the technical solutions worked as planned and the respondents used TDE although the demands on them were comparatively high, we could also recommend TDE to be used not only by PPI but also by other surveys, with similar types of respondents. The experiment is described in Lindström (1995).

2 Response rates in current PPI during 1997

Due to changes in organisation and responsibilities for the survey the implementation of TDE in PPI did not take place immediately after the experiment. To be able to encounter disturbances, TDE was introduced stepwise to parts of the sample. This introduction started only in February 1996.

Not only import prices as in the experiment but also companies reporting export prices and prices on the home market were included. Inclusion rules for companies were more restrictive. Companies which report goods with infrequent or very small price variations during the year are allowed to report their prices for two or more months at one occasion and they do it on paper forms.

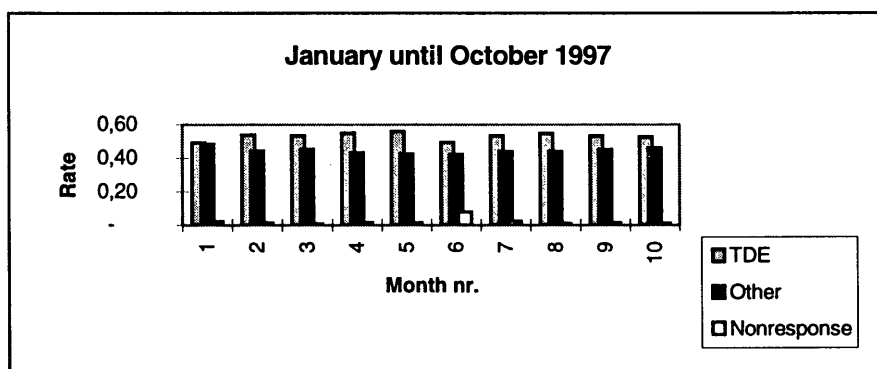
All sampled units of the selected types were offered to register (in February) the prices of January 1997 by TDE. In the beginning of 1997 the gross sample included 1 480 contact persons. 1 280 (86 %) were originally offered to use TDE and finally 1 060 of these were identified as positive to and equipped for registration by TDE. On an average 910 (61 % of the gross sample and 86 % of the TDE-group) use TDE each month. The rate within the TDE-group is almost the same as in the experiment in December 1993. The experiment's rate of TDE users (66 %) within the gross sample is an uncertain predictor as inclusion rules, coverage and nonresponse are different in 1997. However a s.r.s.-approximation of the confidence interval for the outcome of the experiment is $66 \pm 7 \%$ and includes the value of 1997 when selection effects are not taken in regard.

The lower overall TDE response rate during 1997 may depend on several factors. The experiment included import prices only, but the survey covers all prices. The TDE inclusion rules were more restrictive. In the regular surveys respondents reporting goods with rare and small price variations are not offered TDE. Nonresponse and overcoverage in the experiment was close to five and ten per cent respectively and much larger than in production. More detailed studies are needed to tell if technical factors are the explanation

for the difference or if willingness among respondents to use TDE has changed. The relevant observation for PPI is that the TDE response level turned out to be high enough to ensure savings.

It is the same sample during all months and the completed table for all the year that will tell how fast TDE is accepted by the respondents. Each new year a small jump in the time series may appear as there is a rotation of the sample of small companies (the big companies are permanently included) at the turn of the year. About five per cent of the respondents will be offered to use TDE for the first time when they report their January prices. Contact persons are only identified monthly among those who are selected to respond by TDE. An exact calculation of company response rates is laborious to do as there may be more than one contact person at a company and one contact person may split his/her reporting on two or more occasions. The monthly response distributions for all items of goods since January 1997 are shown in Figure 1 and Table 4.

Figure 1: PPI response distribution for items of goods



"Other" includes mail, fax and telephone replies, companies responding for several consecutive months at one occasion and those who have many items to report.

TDE is now the main data collection method, but there is no obvious trend yet. Up to October the monthly TDE rates for goods vary between 49 and 56 per cent and are mostly close to 55 per cent. As companies with many goods use paper forms the response distribution of goods is rather different from the distribution of contact persons. The nonresponse rate is very low except for in June. Table 4 shows the details better.

Table 4: Monthly response rates for goods by mode in PPI during 1997

Month	TDE	Other	Non-response	Net sample
January	0,49	0,48	0,02	4229
February	0,54	0,44	0,02	4226
March	0,54	0,45	0,01	4226
April	0,55	0,43	0,02	4229
May	0,56	0,42	0,02	4226
June	0,50	0,42	0,08	4223
July	0,53	0,44	0,03	4217
August	0,55	0,44	0,01	4204
September	0,53	0,45	0,01	4204
October	0,53	0,46	0,01	4220

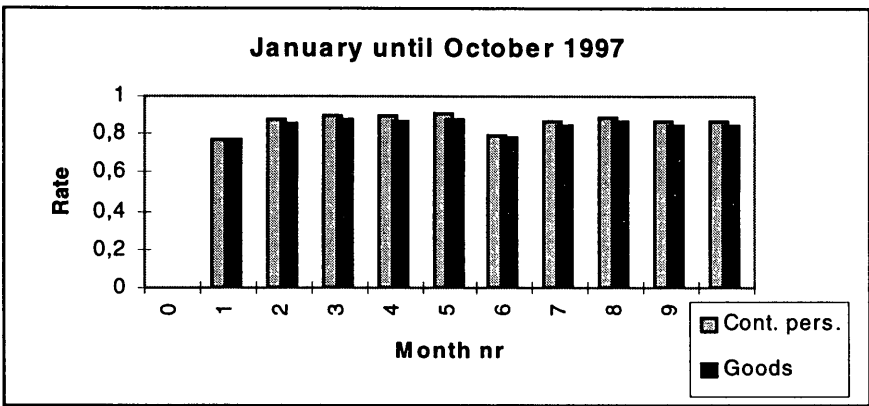
The five percentage points increase in TDE-rate from January to February may depend on the fact that some contact persons in the new panel were unfamiliar with TDE at the start, but learnt the new method quickly. The comparatively high nonresponse rate of June is likely to depend on that vacations in Sweden are most frequent in July.

Figures 2 and 3 show the response distributions in the group of around 1 060 companies that were offered to use TDE. The total number of contact persons who respond by TDE is on average 910 and the number of goods items they report is on average slightly below 2 250. Figure 2 shows that TDE rates are higher for contact persons than for goods every month.

Except for the low values of January and June the TDE response rates vary between 85 and just above 90 per cent for contact persons but one to three percentage points lower for goods.

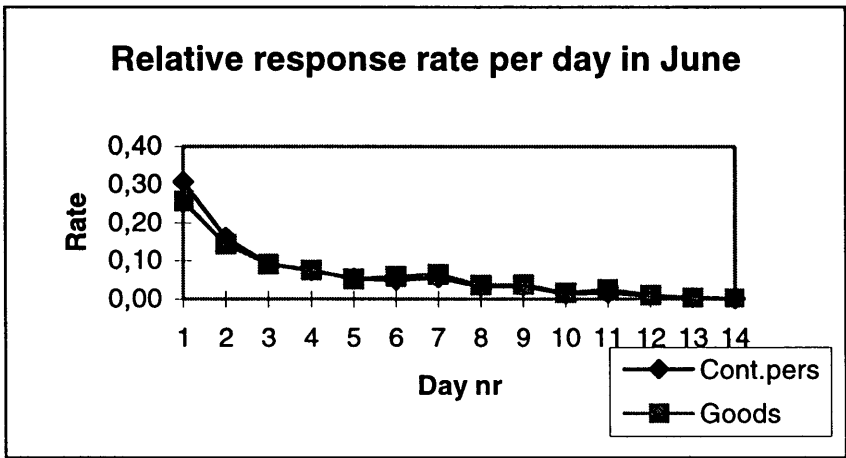
PPI has a rather short data collection period often ranging from 13 to 15 days. The arrival rates per day of the responses varies among the months. The presence of holidays during the data collection period is one important explanation for this.

Figure 2: PPI response rates among contact persons offered TDE



In Figure 3, June 1997 is chosen to represent those months where no holidays interfere. June 2 (day 1) is a Monday and the deadline for data collection is before the beginning of the Midsummer holidays.

Figure 3: Relative arrival rate by day in June 1997. Contact persons and goods items



The arrival rate of goods by day in the TDE group is rather close to the rate of TDE respondents. The response rates during the initial days are higher per contact person than per goods item as Figure 3 shows. There is a slight tendency for contact persons with few items to use TDE more frequently than contact persons in the TDE group with many items, especially obvious during the first few days. Around fifty per cent responded during the first three days. The data inflow follows a simple pattern and has the highest response rates during the first few days of the data collection period. After that the rates, on the whole, decrease day by day.

Some measurements of indicators on the respondent burden for registration and editing are computerised like the time used to register, the number of corrections, the number of spoken comments. The indicators are there to draw attention to such major variations between the months, which may be due to unexpected disturbances. Some variations will be a consequence of variations on the rate of price changes from one month to another. These routines are still under development. Other useful indicators would be the response distribution on "New price", "Same price", "No item sold this month" and the number of corrections distributed on price, goods identity and company identity.

3 Response rates in current STS

In the Short-term Turnover Statistics for Domestic Trade and Services (STS) a company only reports one figure each month/quarter - its turnover during the period of reference. Companies in retail trade report after each month and other companies after each quarter. As the response burden is the same at each occasion for all companies, there was no reason to except some companies from TDE as PPI did. All companies were offered to use TDE, both in the experiment and later when TDE was introduced in production.

The companies in the STS are on average smaller than the companies responding to the PPI. It was feared that the respondents of this survey were less technique-minded and less prone to accept to use TDE so they were approached very softly, when they for the first time were offered to register that way.

During 1996 the TDE response rate of the gross sample was very close to ten per cent in both monthly and quarterly surveys. Even if there is a small cost reduction already at this response level a substantial further reduction was desirable and believed to be within reach as the TDE response rate was substantially below those of MCSA and PPI. Since the respondent burden was lower than in PPI (only one answer, all prizes are given in Swedish currency and no decimal point), there were two main hypothesis to explain for the differences between STS and PPI.

- The populations are different. STS has a larger proportion of small firms in its' sample and fewer of them have the technique/ capacity/ experience/ organisation to respond by TDE.
- The introduction of TDE was too cautious. The respondents did not perceive that it was important for Statistics Sweden that they turned to TDE.

To find answers to the two assumptions an experiment was planned. A sample of 300 enterprises was drawn among the regular sample and equally distributed on three strata by company size. A new introductory letter was written for this experiment group - and these companies no longer received a response envelope. Both the layout and the phrasing of the "new" message indicated very clearly that Statistics Sweden's demand for answers by TDE was strong.

Table 5 presents the outcome of the experiment distributed on strata and the data collection mode chosen by each company.

Table 5: TDE - sample by response mode in three strata by number of employed in the third quarter of 1996

Response mode Number and per cent in an embedded study						Non- response	Net sample size
Number of employed	TDE	Mail	Fax	Phone	All		
Stratum I 0-1	33	33	6	4	76	21	97
<i>per cent</i>	34	34	6	4	78	22	100
Stratum II 2-10	38	43	5	5	91	11	102
<i>per cent</i>	37	42	5	5	89	11	100
Stratum III > 10	41	45	5	6	97	4	101
<i>per cent</i>	41	45	5	6	96	4	100
All strata	112	121	16	15	264	36	300
<i>per cent</i>	37	40	5	5	88	12	100

The effect of the information being more demanding and the absence of response envelopes was strong. The TDE response rate increased from about ten per cent to 37 per cent (unweighted average) of the net sample and 42 per cent among the respondents. The

increase was large in all strata. There are both size and nonresponse effects. A high nonresponse rate in the strata of small companies contributes to a low TDE rate in these. The larger the companies, the larger is also the TDE rate of the net sample and the lower the nonresponse rate. But even in stratum III the level is about 15 percentage points below the TDE response rate of PPI. Probably there is a higher proportion of small companies in STS even in this stratum. Mail was still the dominant data collection mode but TDE came close.

Due to the positive outcome of the experiment it was decided to offer TDE to all companies in the survey. The same information and encouragement as in the experiment was used to prompt them. This was done for the first time when the turnover for January 1997 was to be collected. Table 6 shows the monthly response distributions during 1997. The information to the firms has been uniform through the period as no additional steps have been taken to increase the TDE response rate further. Accordingly the time series show the spontaneous development of TDE use among the contact persons.

**Table 6: Response distribution. Contact persons in per cent during 1997.
Complete monthly and quarterly surveys**

Month	TDE	Mail	Fax	Phone	All re- sponse	Nonre- sponse	Sample size
January	48,5	12,9	10,4	1,2	73	27	2764
February	45,0	10,6	8,4	15,0	79	21	2738
March	43,2	17,7	6,7	10,4	78	22	7723
April	46,5	10,2	9,0	13,3	79	21	2684
May	46,7	10,3	9,9	12,2	79	21	2677
June	40,9	15,9	7,7	11,5	76	24	7372
July	43,8	9,8	12,9	12,5	79	21	2664
August	44,7	8,8	15,4	12,1	81	19	2664
September	43,1	13,7	9,4	15,8	82	18	7202

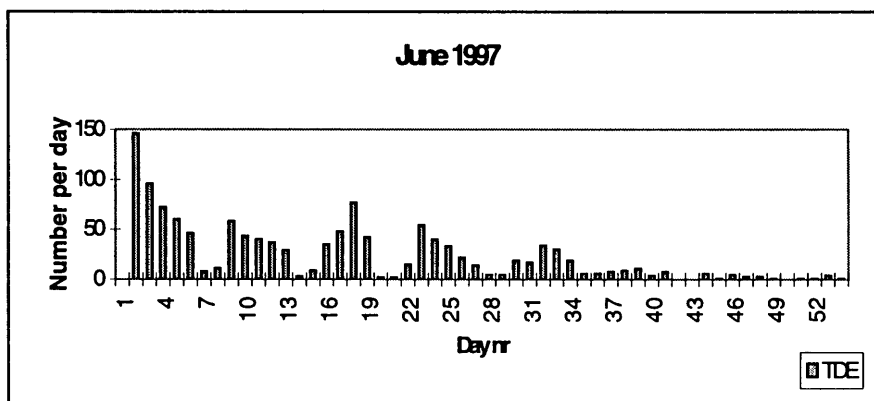
TDE turned out to be by far the dominant data collection mode during 1997. This is in contrast to the experiment where mail was slightly more frequent. In the net sample of 1997 the TDE response rate is higher than in the experiment during all months. No trend is noticed. In average about ten per cent of the respondents chose each of the other modes. The mail response rate is lower but the fax and phone rates higher than in the experiment. A possible explanation for this difference is that in the experiment in 1996 the sample was "old" and had responded by mail since January and was used to put their filled-in forms

in an envelope and mail it. The new sample in 1997 was never given any response envelopes. As a consequence it was more prone to chose TDE. On average the TDE rate of the net sample is about 15 percentage points lower than in the PPI.

The high mail response rates in March, June and September may reflect that the quarterly surveys cover a broader population which is surveyed with larger time intervals. The unweighted nonresponse average in the survey has varied a lot over the years. In 1995 it was 23 per cent and in 1996 only 18 per cent. This material is not analysed enough to verify whether the increase from 1996 to 1997 depends on the introduction of TDE or has other explanations.

The answers are registered by the day they arrived except for answers by phone. Most of them arrive late in the data collection period which is more extended than in PPI. The pattern of inflow is different. June is chosen as an example. Figure 4 shows the arrival TDE rate by day and Figure 5 the cumulative rates for all modes (except telephone) in June 1997. Answers by phone are often a result of a contact made by the STS staff to remind a late respondent.

Figure 4: Number of TDE responses by day during June



The pattern of the number of respondents per day has a number of local peaks and is different from that of PPI.

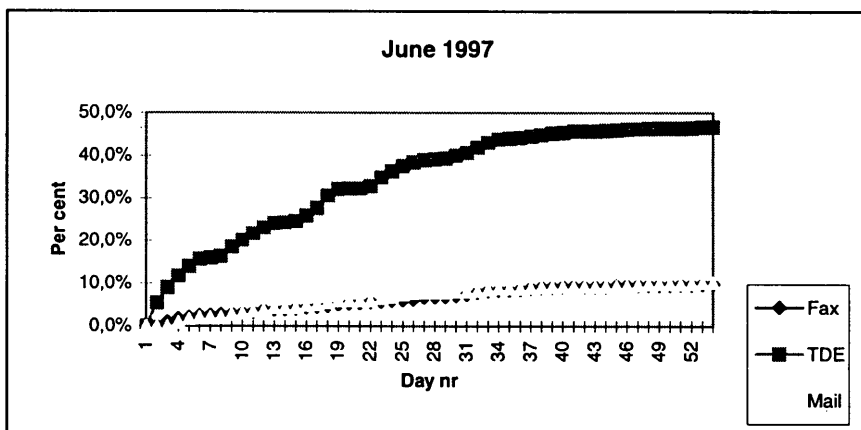
Figure 5: Cumulative response rate by mode in June 1997

Figure 5 shows that those who used TDE tended to respond earlier than respondents by other modes. For example during the first few days of June 1997 the proportion of TDE respondents among all respondents (except telephone) was almost 80 per cent. Thereafter the rate fell slowly and stopped at 70 per cent.

4 Concluding remarks

4.1 TDE in production - a summary

The three examined surveys are all periodical and mandatory. The respondents are companies and municipalities. The recent introduction of TDE has turned the surveys into multi-mode (more than before) surveys with TDE as the main data collection mode. TDE response rates have varied between 40 and 60 per cent of the net sample of contact persons. Differences between surveys depend both on the sampled population and the way to argue for TDE. When the three surveys are compared, PPI has the highest TDE response rate. PPI told the respondents most explicitly that it demanded TDE answers. MCSA started in 1994. Its TDE rate is increasing but it is still 10 percentage points below PPI. STS increased its TDE response rate substantially when it used similar arguments as PPI. Still it is about 15 percentage points below. The lower TDE rates in MCSA may also be due to the importance for respondents to check that sums are correctly recorded or otherwise edit them. So the response burden measured in time at the phone is high even if there only are three sums to register. The time series are still too short to allow any major

conclusions about the trend of the rates, except in one case. In the MCSA there is an increase by two percentage points per year. TDE together with other data collections modes has kept the overall response rates at least at the same level as before in PPI and MCSA. In the STS the case is more dubious as the response rate was higher the year before the introduction but lower than during the year before that.

4.2 Experiment and production

There were reasons to expect good predictive abilities of the experiments, which this report refers to. The experimental conditions were under good control and no problems disregarded. The experiments were embedded and had the best prerequisites to give correct results. Still there turned out to be differences. When it came to production there were sensible reasons not to stick to all the experimental conditions any more. To make inferences from an experiment to the outcome of a continuing survey is obviously a problem that is easily underrated. Production defines its own goals. When these are attained there is seldom time and resources left to verify in retrospect to what degree the results of the experiment were valid.

In the 1993 PPI experiment it was vital that the experiment continued for three months. The conclusion and the decision had been different if we had not adapted the experiment to the experiences of the first month and let it continue two additional months. The TDE rate of the gross sample turned out to be about 5 percentage points lower than in the experimental group. This may be explained by random variation, but different inclusion rules, overcoverage and nonresponse may have caused systematic differences that will not be fully understood without further analysis.

In the STS on the other side the TDE rates turned out to be 5-10 percentage points higher than in the experiment. In this case we think that we know the explanation. The experiment was performed in the second half of the year and the respondents were used to respond by mail. The following year the new panel of the sample did not have this experience and was more prone to use TDE.

As expected, it was not possible to make precise predictions of TDE rates in one survey from experiments or experiences from another. The populations are different, the approach to the respondents is different and so is the response burden and the variation of response burden among respondents.

The observed differences underline the importance of a close connection between experiment and implementation in production together with a subsequent follow-up. This is not without problems. The production staff in each survey is pressed for time and resources and has seldom the time needed to find out in detail how different factors

operate to achieve improvement/changes in their survey as long as the outcome is good enough. They have still less resources for cross-survey comparisons. To make comparisons across surveys - necessary to understand how a method works under different conditions, additional resources must be available for independent evaluators.

4.3 Respondents attitude to TDE

Debriefing of respondents has shown that a large fraction of them accept or even prefer to use TDE rather than shuttle forms. The reason may be that they feel that they are working in a modern way and avoid additional work. If they do the editing well there will be no need for re-contacts to explain and correct. To correct errors immediately is less demanding than to make it one or two weeks later and repeat the whole procedure. The reporting person often has to collect information from others and even make some calculations. To register the information by TDE or in a mail form is only a minor part of the response burden.

4.4 Improved control of the surveys

Except for the savings there are a number of advantages in the TDE part of a sample. There are possibilities to monitor it better and even to increase the response rate. When there is a strong demand for the results to be punctual and the data collection period is rather short, an efficient field work is extremely important. Given that the respondents register the information the same day, independently of the mode they prefer, TDE will reach the statistical agency at least one day faster than mailed responses. As the producer can learn almost instantly if the sampled object has responded by TDE or not there will be no unnecessary reminders in this group as can happen when a filled-in questionnaire is still in the mail.

A contact person is registered for each company/municipality. In many cases, although not in all, the same person reports the answers during several reporting occasions. The production staff will repeatedly get into contact with many of the responding persons and will learn about their attitudes and reporting styles - for example if one has to wait for their answers and if some kind of personal reminder will be necessary. This is, together with an inflow chart of responses per day, very helpful to develop an efficient plan for remainders. There is no need for further registration and less need of editing or contacting respondents again as they mostly already have edited their responses. The possibilities to use production statistics to identify disturbances and to monitor the data collection are still only partially exploited.

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